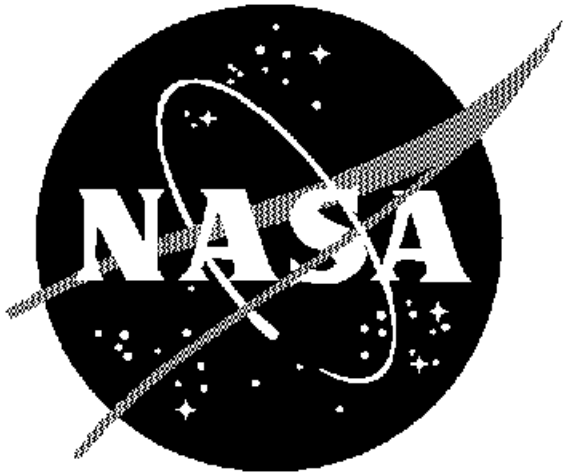

National Aeronautics and Space Administration

May 4, 2001

NRA-01-OES-02

RESEARCH ANNOUNCEMENT

CIRRUS REGIONAL STUDY OF TROPICAL ANVILS AND CIRRUS LAYERS - FLORIDA AREA CIRRUS EXPERIMENT (CRYSTAL - FACE)

Proposals Due July 6,2001

OMB Approval No. 2700-0087

CIRRUS REGIONAL STUDY OF TROPICAL ANVILS AND CIRRUS LAYERS - FLORIDA AREA CIRRUS EXPERIMENT (CRYSTAL - FACE)

NASA Research Announcement
Soliciting Research Proposals
for
Period Ending
July 6, 2001

NRA 01-OES-02
Issued May 4,2001

Office of Earth Science
National Aeronautics and Space Administration
Washington, DC 20546

NASA RESEARCH ANNOUNCEMENT

CRYSTAL-FACE

The NASA Earth Science Enterprise:

The mission of NASA's Earth Science Enterprise (ESE) is to develop a scientific understanding of the Earth system and its response to natural and human-induced changes, thereby improving the predictive capabilities for climate, weather, and natural hazards. Through its science research programs, the ESE aims to acquire a deeper understanding of the components of the Earth system and their interactions. These interactions occur on a continuum of spatial and temporal scales ranging from local and regional to global scales and from short-term weather to long-term climate scales. The Enterprise also seeks to provide accurate assessments of changes in the chemical composition and physical state of the atmosphere; in the extent and health of the world's forest, grassland, and agricultural resources; and in geologic phenomena that lead to natural hazards.

The key research topics studied by NASA's Earth Science Enterprise fall largely into five categories: variability, forcing, response, consequences and prediction. This conceptual approach applies to all research areas of NASA's Earth Science program, although it is particularly relevant to the problem of climate change. The scientific strategy to address this complex problem can be laid out in five fundamental questions, each raising a wide range of cross-disciplinary science problems.

- *1) How is the global Earth system changing (Variability)?*
- *2) What are the primary forcings of the Earth system (Forcing)?*
- *3) How does the Earth system respond to natural and human-induced changes (Response)?*
- *4) What are the consequences of change in the Earth system for human civilization (Consequences)?*
- *5) How well can we predict future changes in the Earth (Prediction)?*

While these five questions define a logical progression in the study of global change, each one covers a range of topics too broad to serve as a simple guide for program implementation. For this purpose, more specific research questions need to be formulated and prioritized.

The strength of NASA's Earth science program is derived from the synergy between different classes of observations, basic research, modeling, and data analysis, as well as field and laboratory studies. In particular, NASA's Earth Science research strategy recognizes the need for close linkage between the observation programs and the data analysis and predictive Earth system modeling programs at all relevant spatial and

temporal scales. Developing the means for full utilization of global observational data (e.g. through systematic data assimilation) and for analysis of discrepancies between observed and modeled fields is considered an essential component of the program. In this respect, NASA's research strategy fully subscribes to the recommendation of the National Research Council's Board on Atmospheric Sciences and Climate (NRC, 1998) to: "Apply the discipline of forecasting… in order to advance knowledge, capabilities for prediction, and service to society". The synergy between global Earth observation, analysis, and modeling is perceived as an essential means to answer these scientific questions and as one of NASA's most important contributions to the U. S. Global Change Research Program.

The intellectual capital for both the planning and exploitation of Earth system observations is vested in a robust research and analysis program. Research and analysis are the conceptual source of Earth system science questions and the strategies to address them. The research program supports the early development of innovative observing techniques (including both instruments and the linkage of instruments with platforms) and processing algorithms, organizes field tests, and generally charts the path for scientific and engineering developments that enable future advances. It assures the linkage between global satellite observations, *in situ* process-oriented observations, and the computational models used to provide both a framework for interpretation of observations and a tool for prediction. It helps assure the development of consistent, integrated, and well calibrated data sets, especially those that involve multiple instruments, observational platforms, and observing techniques. Altogether, the research and analysis program brings fundamental research to bear on key Earth Science issues, and lays the interdisciplinary groundwork for linking these research efforts.

This NASA Research Announcement:

NASA periodically originates process-oriented aircraft-based field campaigns to improve understanding of elements of the Earth System and to provide test opportunities for satellite remote sensing data products. The Cirrus Regional Study of Tropical Anvils and Cirrus Layers – Florida Area Cirrus Experiment (CRYSTAL - FACE) mission will support the scientific objectives indicated below and the validation objectives of NASA satellite programs.

One of the major uncertainties that has limited the confidence scientists place in the results of climate models is the ability of models to accurately represent the formation of clouds and the impact of clouds on the radiation budget of the surface-atmosphere system. The processes that lead to cloud formation and the properties of the resulting clouds must be understood to the extent that the models can realistically represent their behavior in the current atmosphere and in the potentially changed atmosphere of the future. This is particularly true for tropical cirrus clouds which play an important role in the Earth's radiation budget and for which detailed knowledge is lacking. Three questions in the NASA Earth Science Enterprise Research Strategy (http://www.earth.nasa.gov/visions/index.html) are clearly related to the issues of the formation, properties and radiative impacts of cirrus cloud systems.

Specifically:

a) *(Variability) How are global precipitation, evaporation and cycling of water changing?*

Improved knowledge and understanding of upper tropospheric clouds and mechanisms that contribute to their evolution are critical to formulation and verification of methods to realistically capture cycling of water in regional and large-scale climate models.

b) *(Forcing) What trends in atmospheric constituents and solar radiation are driving global climate?*

The impact of cirrus in the tropics on the global distribution of water vapor, particularly cross tropopause mixing, is a key to understanding global chemical and aerosol transports.

c) *(Response) What are the effects of clouds and surface hydrologic processes on Earth's Climate?*

To answer this question, knowledge is required of the global water ice and water vapor fields in the upper troposphere in relationship to the associated global radiative fields and on scales adequate to resolve the dominant physical processes ultimately responsible for their occurrence, e.g., storm and cloud systems.

NASA's investigations of tropical cirrus clouds include satellite, ground-based and aircraft-based in situ and remote sensing observations. In addition, atmospheric models that provide a theoretical context for observations and provide a tool for assessing field data in near real time are an indispensable part of NASA's investigations of clouds. Ongoing NASA satellite programs relevant to cirrus cloud studies include Terra, Aqua and TRMM. The ICESat mission, to be launched in late 2001, will provide unique information on cirrus cloud distributions in altitude and globally.

In keeping with overall NASA goals and those of the Office of Earth Science, research supported by this NRA will be directed toward demonstrating successful use of data from satellite observing systems, in conjunction with other kinds of data, to improve models and data assimilations for the Earth system or one or more of its components.

NASA is presently soliciting proposals for investigations that will contribute to the CRYSTAL-FACE mission to be based in South Florida in the summer of 2002. This NRA specifically solicits proposals pertinent to the development, implementation, and analysis of satellite, in situ and ground-based data gathered during the CRYSTAL-FACE mission. The number of awards anticipated is approximately 50, but will depend on the final selection of aircraft platforms and available resources. Value of the awards is expected to range between 50-150K per year, for an award length of two years. Extended modeling and analysis of data related to CRYSTAL-FACE will be supported through Radiation Sciences Program NRAs and other NRAs that support of the NASA ESE

Research Strategy. The technical plan for this mission, including candidate observation platforms, modeling tools and measurement requirements is provided in Appendix A.

Proposals should also meet the requirements listed in Appendices B through F. Funding for this NRA has not yet been appropriated and NASA reserves the right to cancel this NRA in the event that adequate funds are not appropriated.

Participation is open to all categories of domestic and foreign organizations, including educational institutions, industry, non-profit institutions, NASA Centers, and other U.S. Agencies. In accordance with NASA Policy as described in Appendix B, all investigations by foreign participants will be conducted on a no-exchange-of-funds basis, i.e., investigators whose home institution is outside of the United States cannot be funded by NASA. Proposals may be submitted at any time during the period ending July 6, 2001, 4:30 PM EDT. NASA reserves the optional right to consider proposals received after that date in accordance with Appendix B, i.e., "the selecting official deems the late proposal to offer significant technical advantage or cost reduction". Proposals will be submitted to a peer and/or Program Office review and evaluation. Selected proposals will be announced during August /September 2001.

NASA's policy is to work cooperatively with other U.S. government agencies and our international partners in the development of a comprehensive capability to observe and understand the Earth. In addition, both National and NASA policy require NASA to support private-sector investment in commercial space activities by committing the U.S. government to purchase commercially available goods and services. NASA will not develop a mission that in any significant way competes with or duplicates commercially available goods or services from U.S. industry.

Technical information contained in Appendix A and B applies to this Research Announcement only. Appendices C through F contain NASA general guidelines for the preparation of proposals solicited by this Research Announcement.

Identifier NRA-01-OES- 02
CRYSTAL-FACE

Submit proposals to:
NASA Peer Review Services
500 E Street SW, Suite 200
Washington, DC 20024, USA
Phone: 202-479-9030

Number of Copies Required: 15

Selecting Official:
Dr. Jack Kaye
Director, Research Division
Office of Earth Science
NASA Headquarters

Obtain Additional Information From:
Dr. Donald E Anderson
Manager, Radiation Sciences Program
Code YS
NASA Headquarters
Washington, DC 20546
Phone: 202-358-1432
FAX: 202-358-2770
E-mail: danders1@hq.nasa.gov

Please use identifier number NRA-01-OES-02 when making an inquiry regarding this Announcement. Your interest and cooperation in participating in this opportunity are appreciated.

Proposals submitted to NASA Headquarters will cause a delay in receipt of your proposal, therefore, please adhere to "Submit proposals to" noted above.

ORIGINAL SIGNED BY

Ghassem R. Asrar
Associate Administrator
Office of Earth Science

APPENDIX A

Technical Description of CRYSTAL-FACE

I. INTRODUCTION

CRYSTAL-FACE (Cirrus **R**egional **S**tudy of **T**ropical **A**nvils and Cirrus **L**ayers - **F**lorida **A**rea **C**irrus **E**xperiment) is a focused mission of modeling, observations and integrated analyses designed to investigate tropical cirrus cloud systems and their roles in both regional and global climates. Satellite observations will be utilized in mission planning and to provide coincident data to assist the development of global retrieval of cirrus cloud cover. Specific flight segments will be designed to assist validation of EOS Terra, Aqua and ICESat investigations.

The largest gaps in our understanding of global cirrus effects on climate involve tropical cirrus systems. High-level clouds dominate the cloud radiative forcing signal in the tropics. Tropical cirrus systems usually originate from water transport in deep convective cloud clusters, however a wide range of upper level cloud types may result from such convection. These include thick precipitating anvil clouds directly tied to the convective cells, moderately thick non-precipitating anvils, and the thin cirrus that are a fairly ubiquitous feature of the tropics. In addition, *in situ* observations of cross tropopause transports, will provide improved understanding of global chemical transport and the impact of the tropics on the global distribution of chemicals and aerosols in the troposphere and stratosphere.

Three overarching issues provide the context for CRYSTAL-FACE:

1) It is essential to gain improved knowledge of the global water ice and water vapor fields in the upper troposphere in relationship to the associated global radiative fields and on scales adequate to resolve the dominant physical processes ultimately responsible for their occurrence, e.g., storm and cloud systems.

2) An improved knowledge and understanding of upper tropospheric cloud generation, re-generation, and dissipation mechanisms are critical to formulation and verification of methods to realistically capture these processes in regional and large- scale climate models.

3) The impact of cirrus in the tropics on the global distribution of water vapor, particularly cross tropopause mixing, is a key to understanding global chemical and aerosol transports.

Examples of scientific questions that CRYSTAL-FACE will address are:

- How are the radiative, microphysical and spatial properties of tropical cirrus anvils and associated cirrus cloud systems related to the precipitating deep convective cloud systems that produce them?

- How do tropical cirrus cloud system radiative properties, microphysical properties and spatial properties evolve with time through the entire lifecycle of the cloud systems and what are the controlling factors in this evolution?

- How is the humidity of air entering the stratosphere and air in the upper troposphere controlled? What processes control the dehydration of air to low stratospheric moisture levels? What roles do the optically thin cirrus near the tropopause play in dehydration? Does deep convection moisten or dehydrate the upper troposphere?

- How can we best observe tropical cirrus cloud systems in a large-scale context for climate research *in situ* and from satellite platforms?

- How do tropical cirrus cloud systems impact local, regional and global circulations (and climate)?

CRYSTAL-FACE will utilize both numerical modeling and observational approaches. Numerical models of atmospheric circulation, ranging from cloud scales to global scales, including numerical weather prediction (NWP) models, will be employed. Observations from the ground, satellite and aircraft platforms will be used to initialize the models, verify portions of their results, and develop new methods of parameterizing cirrus cloud production and evolution. Characterization of tropical cirrus properties and evolution will require *in situ* as well as remote sensing measurements. The *in situ* observations will include air motion, temperature, water vapor and its isotopes, cloud ice/water, microphysical properties, and radiation. The observations will be collected in modes supporting the investigation of time evolution of specific systems, compositing data from multiple events, and developing local case studies. Sampling of cirrus near the tropopause requires a high-altitude aircraft, accurate and precise water vapor sensors, and instrumentation capable of characterizing small ice crystals (1–20 microns).

Satellite remote sensing has been a central theme of CRYSTAL-FACE's scientific predecessors throughout the First ISCCP Radiation Experiment (FIRE) investigations of cloud systems. CRYSTAL-FACE will play a crucial role in providing validation opportunities for Terra, Aqua and ICESat cloud property retrieval algorithms. Beyond validation of existing algorithms, the data set generated by the CRYSTAL-FACE field campaign will support development of future satellite retrieval schemes (PICASSO-CENA, CloudSat, EOS-Aura) for the retrieval of cirrus cloud properties and upper tropospheric water .

Past tropical cirrus measurement programs have generally lacked instrumentation capable of accurately characterizing small (< 20 micron) ice crystals. Detection and sizing of small crystals is particularly important for understanding the impacts of optically thin cirrus near the tropical tropopause and cold cirrus (<-50°C) in general. The CRYSTAL-FACE field experiments will take advantage of recent instrumentation advances allowing digital imaging of these small ice crystals.

II. CIRRUS CLOUD MODELING APPROACH

Studies to date have shown that cloud feedbacks in the climate system represent the largest uncertainty (by a factor of 3) in attempting to predict the impact of increasing greenhouse gases over the next century. Cloud/climate feedbacks in turn comprise three major components:

- Given an atmospheric state, predict cloud liquid and ice water distribution
- Given the cloud liquid and ice water distribution, predict the solar and thermal infrared radiative fluxes from the top of atmosphere, throughout the atmospheric column, and at the surface.
- Incorporate the items above into a global climate model that then allows the changes in radiative heating/cooling to appropriately modify the atmospheric state, thereby completing a realistic feedback loop.

To increase our confidence in cloud/climate feedback predictions, three types of models are required:

- Cloud System Models (CSMs) to simulate cloud formation, microphysical, and cloud-scale dynamical processes on local to regional scales.
- Radiative Transfer (RT) Models to determine the effects of a given distribution of cloud ice and liquid water on radiative heating/cooling rates.
- General Circulation Models (GCMs) to simulate the collective effects of an ensemble of such clouds on the large-scale energy balance and general circulation.

The process of parameterization development and validation is necessarily iterative, involving significant collaboration between the CSM and GCM communities. This is the strategy that has been adopted by the Global Energy and Water Experiment (GEWEX) Cloud System Study (GCSS), and potential CRYSTAL-FACE cloud modelers will be encouraged to participate in the GCSS Working Groups, especially #2 (Cirrus) and #4 (Deep Convective Clouds. GCSS is an umbrella that serves to organize an array of individual modeling activities. CRYSTAL-FACE will make an important contribution to GCSS through its coordinated cirrus observation and modeling activities.

The specific modeling support requested for this NRA is identified in Table 9.

III. SITE SELECTION AND EXPERIMENTAL DESIGN

The proposed field program is designed to address four classes of issues:

- Validation of remotely sensed cirrus cloud properties, both from the surface and from satellite.

- Simultaneous measurements of cirrus microphysical properties and radiative effects throughout the cloud lifecycle.

- Relate the properties of deep convective systems (such as core updraft speed, lifetime, and convective mass and water flux) to the generation of cirrus anvils and to horizontally extensive cirrus clouds that can persist for days.

- Improve our understanding of transport, ice clouds, and dehydration in the tropical tropopause layer.

The south Florida area offers extensive assets in the form of rawinsondes, Doppler radar, and opportunities for surface based remote sensing. Data from these assets will be applied to documenting the relationships between dynamics and cirrus clouds observed by remote sensing systems and *in situ* systems, thus linking the observational program to cirrus cloud model development. These relationships are essential to coupling ice water production by convection to the upper tropospheric cirrus cloud layer – a key element in the successful modeling of the Earth's climate.

Taking Advantage of Unique Observational Strategies

CRYSTAL-FACE offers observations including substantial rawinsonde support offered by the United States National Weather Service, opportunity for numerous surface site observations, multiple Doppler radars to document convective system mass flux, and numerical model support in a relatively data rich environment.

Because of the availability of multiple assets to assess the atmospheric dynamics attending cirrus cloud formation and lifecycle, documentation of the relationship between dynamics and cirrus cloud systems will be an emphasis of the Florida campaign.

IV. FIELD PROGRAM DESIGN

Remote sensing will constitute an important part of the field campaign by providing the horizontal distributions of vertically integrated cloud properties at a variety of spatial and temporal scales. In addition to equivalent coverage by polar and inclined orbit satellites at each location, the location of CRYSTAL-FACE also allows utilization of near-

continuous GOES satellite observations. Airborne and surface-based remote sensing systems will be heavily utilized to describe the spatial (especially vertical) and temporal structure of the cloud systems. The proposed mode of observation will utilize a combination of at least three aircraft, special surface sites, and a number of satellite sensors including Terra, Aqua, ICESat and GOES. Island sites may be used for, e.g., Andros Island, but the main surface site will be in the Florida Everglades. Measurements from a ship are not currently part of the mission plan.

Time and Location

The intended site of airborne observations is the waters off the tip of southern Florida, including the Florida Keys. The anticipated base of airborne operations is Jacksonville Naval Air Station, located on the northern Atlantic coast of Florida, about 600 km from the Florida keys (see Fig 1). This base is far enough from the intended site of observations to limit the impact of the observed weather systems on airborne operations (e.g., ER-2 and WB-57F take-off and landing constraints), yet close enough to afford acceptable transit times.

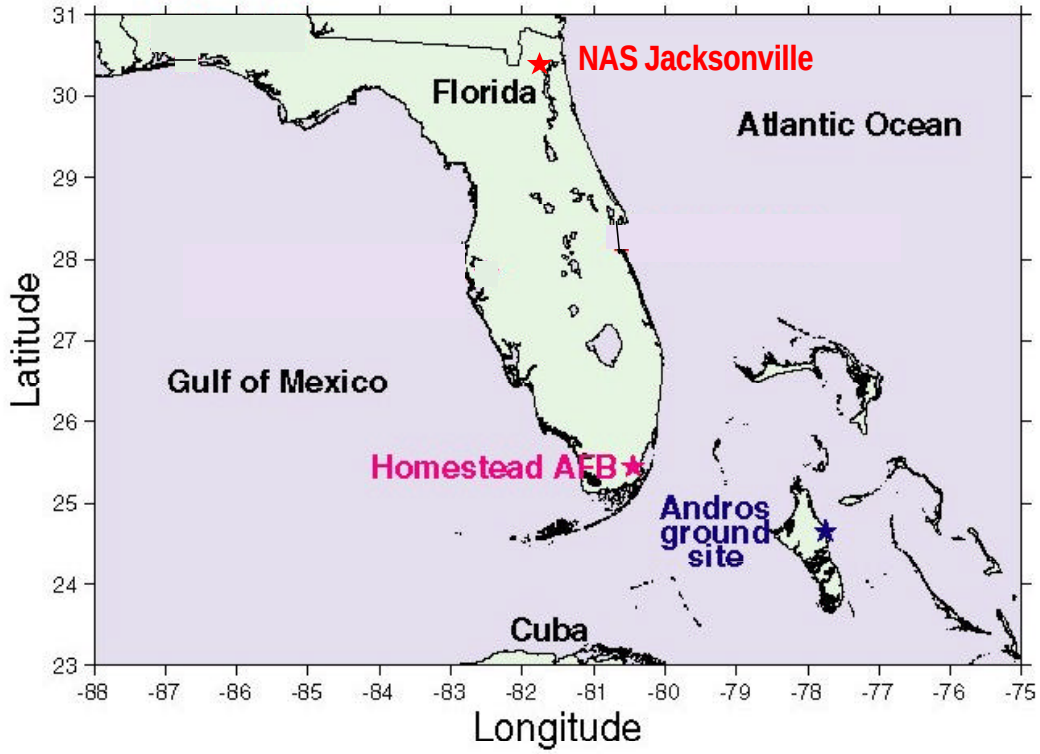

Figure 1. South Florida Operations area – CRYSTAL-FACE

Ground-based remote sensing equipment may be located at a site in the Florida Everglades. Other possible locations include the Florida Keys and Andros Island (located about 250 km east of the Florida Keys). NASA recently used Andros Island for similar installations during CAMEX-3. The Everglades site is particularly attractive because of the tendency for cirrus outflow from offshore (to the southwest) convective

disturbances to advect over this site in a generally southwesterly flow aloft. The preferred time for this experiment is June-August 2002.

Instrument Platforms

The following references to specific platforms and instruments are not meant to be either inclusive or exclusive. **The particular platforms or instruments identified are intended only to represent classes of observational capabilities.** Other platforms/ instruments of equal or superior capability would certainly be considered. Preferred airborne platforms are the NASA ER-2, NASA WB-57F, Citation, and the NRL-P3 which supports the ELDORA radar.

The NASA WB-57F provides the capability to obtain a broad range of *in situ* measurements in the tropical upper troposphere and lower stratosphere from 10-20 km, including microphysical, aerosol, chemical and state variables. A high-altitude aircraft such as the WB-57F is required for direct observations of the upper portions of high tropical cirrus systems. Both the ER-2 and WB-57F are capable of deploying dropsondes for characterization of the overall state of the atmosphere within the sample region, i.e., temperature and wind profiles. The higher altitude and flight patterns typically used for the ER-2 (long legs giving greater spatial separation between sondes) make this the preferred platform for dropsondes.

The Citation will provide a second *in situ* aircraft for sampling the lower parts of cirrus anvils. The smaller, more durable aircraft would also be capable of sampling cloud microphysical composition closer to active convection. The utility of this class of aircraft for sampling convective clouds has been demonstrated in many past field experiments.

The NCAR ELDORA Doppler rain radar provides a unique airborne capability to measure the convective mass and water flux associated with deep convection. The capability to adjust the sample volume to the geometry of a specific convective system is a tremendous advantage over fixed surface-based systems, e.g., the capability to fly box patterns around a convective line as done in TOGA-COARE.

Land-Based Sites

For CRYSTAL-FACE, ground-based measurements may be obtained from a site in the Florida Everglades. Desired measurements include a millimeter-wavelength cloud radar, a sophisticated cloud lidar system, and a variety of passive remote sensing instruments. Also of value, both to operations as well as to characterization of the convective systems are observations from the NOAA NEXRAD system in South Florida. Deployment of an additional mobile Doppler rain radar to the Everglades site would be a significant enhancement. It would be particularly valuable if an MMCR-class radar were deployed at this location because of the inherent sensitivity and water attenuation differences, ~ 10 db greater sensitivity than that of any research grade 94 GHz radar. Ground-based measurements from other sites are also possible, such as Andros Island. Finally, CRYSTAL-FACE will benefit from the availability of routine operational rawinsonde soundings over the region—from mainland and island sites—and the consequent improved quality and resolution of the NCEP operational analysis in this region.

Enhancements to the operational sounding schedule should be strongly considered, as 3-hourly soundings provide a markedly superior description in convective situations.

The proposed platforms for CRYSTAL-FACE deployment data collection are listed in Table 1. Proposers are reminded that the following are intended to represent a class of observational platforms and instruments. Other platforms/instruments of equal or superior capability would certainly be considered.

Table 1. Mission/Candidate Platforms

MISSION	CANDIDATE PLATFORMS
Remote sensing observations for h > 13 km	NASA ER-2
In situ microphysics observations 13 < h < 18 km 8 < h < 13 km	 NASA WB-57F Citation
Remote air motion/precipitation	NCAR – (NRL-P3)
Remote sensing cloud and water vapor observations, meteorological observations	NCAR –(NRL-P3) UK Meteorological Office Research Aircraft (new)
Surface-based observations Remote sensing	Everglades site Possible other sites (e.g., Andros Island, Key West)
Rawinsonde	Enhanced routine upper air soundings Special rawinsonde observations ER-2 - dropsonde Other sites (TBD)
Satellite remote sensing	EOS Terra, EOS Aqua, ICESat GOES, NOAA Polar Orbiters TRMM DMSP LANDSAT, ERS-1 and -2

Measurements

To achieve the mission objectives, a comprehensive suite of radiative, microphysical, and remote sensing measurements is required. CRYSTAL-FACE seeks to characterize and quantitatively relate cirrus cloud microphysical and radiative properties and to quantitatively understand the process of cirrus generation via deep convection and the subsequent cloud evolution in an environment subject to mesoscale and large-scale dynamical controls, as well as radiative forcing.

The basic radiative measurements are the upwelling and downwelling solar and infrared irradiance both above and below cirrus cloud decks from aircraft and from surface-based systems. These measurements should be of sufficient accuracy that the radiative flux divergence and associated heating rates can be reliably derived. In order to better understand the transmission of solar radiation and issues related to cloud absorption, spectrally-resolved measurements of the solar irradiance are highly desirable. Solar and infrared imagers, particularly those that simulate satellite observations, are also an important component of the aircraft payload.

Measurements of cloud macrophysical and microphysical properties are essential to the success of the proposed experiment. Remote sensor determinations of cloud boundaries from above and below cloud are required (e.g., cloud lidar). Measurements from below include both aircraft and surface-based systems. Ice water path and profiles of ice water content are critical measurements (e.g., mm radar). A wide variety of *in situ* cloud microphysical measurements are needed including, but not limited to, measurements of ice crystal size distribution, ice crystal shape (habit), and aerosol size distribution. Because small ice crystals are likely to be an important component of tropical cirrus, measurements of crystals as small as 5 microns are critical, while measurements to 1 micron are desirable. The focus of the high altitude aerosol measurements is expected to be on those aerosols that serve as ice crystal nuclei. Thus, measurements of aerosol composition are highly desired, especially for the larger size particles. Additionally, it would be useful to measure cloud condensation nuclei concentration in the boundary layer using a low-altitude aircraft.

Aircraft altitude for the *in situ* platforms will be a prime consideration. It is expected that two microphysical aircraft will typically be required: one for altitudes below 13 km and another for altitudes above 13 km. Use of two *in situ* microphysical aircraft is optimal even in the "simple experiment" design because of the substantial depth (3-5 km or more) of many tropical cirrus systems, the consequent time required to obtain microphysical profiles using an aircraft, and the central importance of microphysical profile information to the science objectives.

Critical to the success of efforts to quantitatively understand the linkage of deep convection to anvil production are measurements of the size and intensity of convective systems, and particularly of cumulus mass and water flux. Such measurements will be made by airborne and surface-based Doppler radar. In addition, down-looking Doppler precipitation radar measurements from above cloud top are highly desirable for completing the characterization of the convective core region and surrounding dense outflow. Such measurements would complement the millimeter wavelength radar observations of cirrus cloud properties in the anvil and extended cirrus outflow.

Measurements of environmental variables are also essential to the success of this experiment. Airborne high-frequency *in situ* measurements of temperature, relative humidity, turbulence, and vertical velocity are required within the cirrus clouds and also in the surrounding clear air. Accurate water vapor measurements are particularly important since many of the issues concerning cloud effects on the water budget hinge on

accurate relative humidity determination. To enable diagnostic studies and modeling of the coupled deep-convection and cirrus-cloud system, measurements (soundings) of environmental temperature, relative humidity and horizontal velocity are required over a larger domain surrounding the convective system. This enables characterization of the larger-scale forcing and response and provides an independent measure of convective intensity and mass flux. Sounding will be made from surface-based systems as well as via dropsondes from high-altitude aircraft. Data assimilation, such as produced by NCEP, ECMWF and DAO, are expected to add substantial value to these data and provide essential information about the large-scale environment and forcing.

Finally, relating the observed clear-sky water vapor concentrations to convective source regions will require measurement of tracers that provide information about the dynamic history of the air mass (e.g., CO, O_3, HDO, ^{222}Rn, aerosols, etc.). O_3 and CO, for example, act like a "clock," providing information about how long the air mass has been in the upper troposphere. HDO in concert with H_2O, on the other hand, provides information about the temperature history of the air mass. Such measurements are crucial for understanding how water vapor near the tropopause is regulated. In particular, these measurements will help us sort out the contribution of convective dehydration to dehydration that occurs after detrainment from convection (e.g., through growth and sedimentation of sub-visible cirrus particles).

Table 2 identifies the table numbers for each of the candidate platforms. Tables 3-10 summarize the proposed measurements for CRYSTAL-FACE for each platform. Each entry also contains a priority as assigned by the drafting panel as follows.

Priority 1 = Absolutely essential
Priority 2 = highly desired; if absent, may have to modify scientific objectives
Priority 3 = Desirable; if absent, minor impact on objectives

Table 2. Table Number Locations for Platforms

Platform	Table Number
NASA ER-2	3
NASA WB-57F	4
Citation	5
NCAR (NRL-P3)	6
Ground Station(s)	7
Satellites	8
Modeling in Support of Field Activities	9

Table 3. NASA ER-2

Platform/Activity	Desired Measurements	Observed/Derived/ Inferred Parameters	Priority
NASA ER-2 (down-looking remote)			
	solar and IR irradiances - up and down	calculated radiative flux divergences heating/cooling rates	1
	spectrally-resolved solar irradiances	cloud parameters	2
	multispectral radiance images	cloud parameters: top altitude optical thickness effective particle size thermodynamic phase reflectance ice water path	1
	interferometric radiances	temperature profile water vapor profile sea surface temp cloud height cloud emissivity, effective particle size, phase, and ice/liquid water content	2
	profiles of: differential lidar backscatter lidar backscatter and depolarization	vertical structure of cloud water vapor cloud height cloud particle habit	1
	cm Doppler radar	characterization of convective cores	2
	mm-radar reflectivity profile	Ice water content vertical structure effective particle size	1
	spectral sub-mm radiances	ice water path effective particle size	1
	microwave brightness temp.	ice water path	2
	meteorological profiles	profiles: p(z), T(z), T_d(z), u(z), v(z)	2

Table 4. NASA WB-57F

Platform/Activity	**Desired Measurements**	**Observed/Derived/ Inferred Parameters**	**Priority**
NASA WB-57F (*in situ* top):			1
	cloud microphysical parameters	cloud particle: concentration size distribution ice water content phase habit scattering phase function	1
	aerosol parameters	aerosol size distribution concentration aerosol composition ice nuclei	1
	ice crystal surface chemistry	ice surface chemistry and related gas-phase species: NOy, HNO_3	3
	meteorology	T, p, RH, u, v	1
	water vapor	water vapor mixing ratio	1
	chemical tracers	O_3, CH_4, CO, etc. H_2O isotopes, radon	1
	turbulence	parameter fluxes	2
	solar and IR irradiances (up and down)	calculated radiative flux divergences heating/cooling rates	1
	differential lidar backscatter and depolarization	vertical structure of cloud height particle habit	3

Table 5. Citation

Platform/Activity	**Desired Measurements**	**Observed/Derived/ Inferred Parameters**	**Priority**
Citation (*in situ* bottom):			
	cloud microphysical parameters	cloud particle: concentration size distribution ice water content phase habit scattering phase function	1
	aerosol parameters	aerosol size distribution concentration aerosol composition Ice nuclei	1
	meteorology	T, p, RH, u, v	1
	water vapor	water vapor mixing ratio	1
	solar and IR irradiances (up and down)	calculated radiative flux divergences heating/cooling rates	1

Table 6. NCAR (NRL-P3)

Platform/Activity	Desired Measurements	Observed/Derived/ Inferred Parameters	Candidate Instruments	Priority
NCAR Aircraft (side looking remote):				2
	solar irradiances - up and down	radiative flux divergences heating/cooling rates	flux radiometers	2
	IR irradiances - up and down	radiative flux divergences heating/cooling rates	flux radiometers	2
	backscatter profile - up looking	vertical structure of cloud height	cloud lidar:	3
	scanning Doppler precipitation (cm) radar	convective mass fluxes structure of convection	ELDORA	1
	radar reflectivity profile	vertical structure of cloud height particle habit	mm radar	3
	Cloud condensation nuclei		CCN spectrometer	2
	meteorology	T, p, RH, u, v	T, p, RH, u, v	1

Table 7. Ground Station(s)

Platform/Activity	Desired Measurements	Observed/Derived/ Inferred Parameters	Candidate Instruments	Priority
Ground Station(s)				1
	direct beam solar irradiances	spectral aerosol optical depth	MFRSR or CIMEL	1
	microwave brightness temp	integrated water vapor/liquid water	microwave radiometer	1
	spectral radiances - up and down	IR radiances surface skin T	M-AERI IR spectrometer - up - down	2
	solar flux	solar flux	solar flux spectrometer (0.4 - 2.5 μm)	1
	backscatter and depolarization profiles	scattering ratio cloud base height depolarization ratio extinction coefficients particle phase particle orientation relative optical depth	cloud/aerosol lidar (to 20 km)	1
	Doppler mm-radar reflectivity	ice/water profiles effective particle size	Doppler cloud mm-radar	1
	meteorology	p, T, RH, u, v	p, T, RH, u, v	2
	T, RH, u, v, p, time profiles	profiles: p(z), T(z), T_d(z), u(z), v(z)	rawinsondes (4/day)	1

In Table 8 below, operational, or near operational, products important to the mission are shown. Terra, Aqua and ICESat are not included, as their products are not considered as operational. CRYSTAL-FACE will support detailed validation of the cloud and aerosol products provided by these missions. In addition, research products available during CRYSTAL-FACE, e.g. regionalcloud/aerosol content and time evolution, will be utilized in mission planning and subsequent modeling and analysis of the data.

Table 8 Satellites

Platform/Activity	**Desired Measurements**	**Observed/Derived/ Inferred Parameters**	**Candidate Instruments**	**Priority**
NOAA Polar Orbiters (9:30 am, 1:30 pm) Combined NOAA and Metop satellites beginning in 2004	lambertian reflectance at 0.58 - 0.68 and 0.725 - 1.10 µm brightness temperature at 3.55 - 3.93, 10.3 - 11.3, and 11.5 - 12.5 µm TOA VIS image TOA IR image TOA VIS radiance TOA IR radiance	cloud fraction cloud optical thickness cloud particle size cloud top temperature cloud IR emissivity cloud albedo cloud reflectivity clear sky albedo clear sky temperature cloud liquid water temperature profile water vapor profile cloud height cloud amount	AVHRR: GAC HRPT AMSU TOVS: HIRS	 1 1 1 1

Table 8 (Continued)

GOES	TOA 0.55 - 0.75 µm radiance 3.9, 11 & 12 micron brightness temperatures TOA IR image	cloud fraction cloud optical thickness particle size cloud top temperature cloud liquid water cloud IR emissivity cloud albedo cloud reflectivity number of cloud layers clear sky albedo clear sky temperature temperature profile water vapor profile cloud height, cloud amount	VISSR	1
ADEOS II (10:30 am)		T(p), q(p), SST Aerosol/cloud polarization Sea surface winds	AMSR-E POLDER	2 2
DMSP (Sun-Synchronous)	TOA VIS radiance TOA IR radiance TOA microwave radiance TOA microwave radiance	cloud structure total cloud liquid water estimate water vapor precipitation rate surface wind SST temperature profile	Imager: SSM/I SSM/T1 SSM/T2	3 2 3 3
ERS-1 and -2	along track scan of TOA radiance	SST cloud liquid water surface wind stress		3
TRMM	TOA VIS radiance TOA IR radiance TOA microwave radiance, Radar Reflectivity	Same as AVHRR, except with directly measured broadband radiances liquid water path rainfall lightning	CERES VIRS TMI LIS PR	3 3 3 3 3

Table 9. Modeling in Support of Field Experiment

Platform/Activity	Desired Models	Observed/Derived/ Inferred Parameters	Priority
Cloud-scale modeling	Cloud resolving models Radiative transfer models	Cloud processes Radiative forcing calculations	1
Large-scale model support	Regional-scale models Local weather meteorology Tracer transport analysis	Forecasts Trajectories Reanalyzed data sets (e.g., NCEP, ECMWF, DAO)	1

PROGRAMMATIC CONNECTIONS

In addition to the past and continuing basic Research and Development (R&D) programs funded by a variety of agencies including the DOD, the NSF, the NOAA, the DOE, and the NASA, there are three focused national programs and one international program that are of particular relevance to CRYSTAL-FACE and achievement of its objectives: EOS, DOE ARM, and GEWEX GCSS.

Earth Observing System (EOS):
Implementation of the centerpiece of NASA's Earth Science Enterprise, EOS, began in earnest in 1999 with the launch of Landsat 7 and the Terra platforms. The Terra satellite carries an advanced instrument suite for sensing the Earth in the visible and infrared wavelengths with the following instruments: Advanced Spaceborne Thermal Emission and Reflection radiometer (ASTER), Clouds and the Earth's Radiant Energy System (CERES), Multi-angle Imaging Spectro-Radiometer (MISR), Moderate-resolution Imaging Spectrometer (MODIS), and Measurements of Pollution in the Atmosphere (MOPITT). This mission will be complemented with the launch of Aqua in 2001. Aqua will carry MODIS and CERES, the Advanced Microwave Scanning Radiometer (AMSR/E) and the Atmospheric Infrared Sounder (AIRS)/ Advanced Microwave Sounding Unit (AMSU)/ Humidity Sounder for Brazil (HSB) instrument suite. Observations from these two platforms will enable advances in the detection and characterization of tropospheric cloudiness with global coverage from a polar orbit.

The Stratospheric Aerosol and Gas Experiment III (SAGE III) instrument will be launched on board the Russian Meteor 3M spacecraft in 2001 and also placed on the International Space Station in 2005. These instruments will provide additional data to characterize water vapor, clouds and aerosols in the upper troposphere. If SAGE II is still operating it will continue to provide similar products.

ICESat will be launched in 2002 and will provide lidar remote sensing of cirrus clouds. CRYSTAL-FACE will provide an opportunity for testing and validation of the retrieval of cirrus cloud altitude distributions.

The DOE Atmospheric Radiation Measurement (ARM) Program:
The ARM program of DOE is currently developing a series of instrumented ground-based remote sensing sites in the Tropical Western Pacific area. These sites measure all the components of the surface radiation budget, surface meteorology and cloud properties A partnership is emerging between the EOS Validation Program and ARM, and between ARM and NASA's Radiation Sciences Program. For CRYSTAL-FACE, there is the possibility of deployment of a "mobile" ARM CART ground site to south Florida. The two programs are intrinsically linked and close coordination will enhance efforts in both programs.

As in NASA, the ARM program has also been active in the development of research capability using unmanned aerospace vehicles (UAVs). The UAV program has developed and flown radiometers, a small lidar, and an imager on several UAV platforms. It is possible that such a platform could be deployed in support of the CRYSTAL-FACE campaign.

Global Energy and Water Cycle Experiment (GEWEX) Cloud System Study(GCSS):
Use of CSMs to bridge the gap between observations and large-scale models is the cornerstone strategy of GEWEX GCSS, an international coordinated effort to enhance progress toward improved treatment of cloud processes in GCMs used for both numerical weather prediction and climate studies. CRYSTAL-FACE would provide significant support to, and gain substantial benefit from, GCSS activities focused on cirrus cloud systems (GCSS Working Group 2). In addition, there will be opportunities for synergy between CRYSTAL-FACE and other GCSS Working Groups, e.g., GCSS Working Group 4 is concerned with deep convective systems and has a strong tropical focus.

APPENDIX B

SPECIFIC GUIDELINES FOR PROPOSERS TO THIS ANNOUNCEMENT

I. PURPOSE

These guidelines contain general and specific information regarding the submission of proposals in response to this NRA. Suggested formats and mailing information for submission of proposals for research related to this program are also provided. Appendix C contains general instructions for responding to NASA Research Announcements. Where conflicts exist between this appendix and Appendix C, this appendix (B) shall be the controlling document.

II. GUIDELINES FOR PARTICIPATION

This Research Announcement solicits proposals for experimental investigations that address objectives of the CRYSTAL-FACE mission as set forth in Appendix A. It also solicits proposals for modeling studies in direct support of the mission as identified in Table 9 of Appendix A. A strong integration of airborne, ground-based, and satellite-based data, with modeling investigations will be needed to meet the mission objectives. Proposals are also solicited for the roles of Mission Meteorologist(s) to assist in flight planning, but such proposals should be submitted as a part of a broader experimental or theoretical investigation that will address the objectives of the CRYSTAL-FACE mission.

Proposals for experimental investigations that have not been tested in the field to verify accuracy, precision and reliability under mission conditions are not solicited, nor are proposals for extensive model development or the acquisition of major computer hardware and software. In cases where a unique measurement capability is still under development by the close of this announcement, a proposal may be considered if there is a high probability that field tests will be performed before mission integration begins. Proposals for project management or logistics support are also not solicited by this NRA.

Participation is open to all categories of domestic and foreign organizations, but proposers from non-U.S. organizations will not be eligible to receive NASA funding, except that NASA will integrate selected foreign experiments onto the designated aircraft and will pay all costs associated with operation of the aircraft. Applications for participation in this program can be made through submission of a proposal to the Research Division of Earth Sciences Enterprise (ESE), National Aeronautics and Space Administration Headquarters, Washington, DC. After a review and evaluation of the proposals received, the Director of the Research Division will select the experimental and theoretical investigations to be supported. NASA will provide financial support for the selected U.S. investigations.

III. GENERAL INFORMATION ON CRYSTAL-FACE

A. Program Management

Close interagency cooperation in the past has made possible advancements in our understanding of these climatically important cloud systems. It is intended that this spirit of interagency cooperation will be maintained.

While NASA will provide overall management of the mission, other federal agencies including National Science Foundation (NSF), Office of Naval Research (ONR), Department of Energy (DOE), Department of Defense (DOD), and National Oceanic and Atmospheric Administration (NOAA) are encouraged to be strong participants.

B. Project Management

The NASA Ames Earth Science Projects Office (ESPO) will manage the CRYSTAL-FACE project activities. The ESPO website is: http://cloud1.arc.nasa.gov/start/ . The project manager will be responsible for the overall management, coordination, and reporting of the project activities

C. Available Documentation

A broad overview of the motivation for CRYSTAL-FACE may be obtained from the historical document the FIRE IV CRYSTAL Research Plan at:

http://eosweb.larc.nasa.gov/ACEDOCS/index.html

D. Pre-Proposal Briefing

A pre-proposal briefing is deemed unnecessary.

E. Logistical Support Provided by NASA

During the field deployment of CRYSTAL-FACE, the NASA Ames ESPO will provide the logistical arrangements and funding for shipping investigator equipment between the payload integration sites and deployment sites. As individual experimenters will require separate trips for integration and subsequent deployment, they should include the costs for shipping to and from their home labs to the integration site and from their home labs directly to and from the deployment site. The ESPO will arrange consolidated advance shipments for large or hazardous items (such as compressed gases) from the integration sites to deployment sites via surface transportation.

The ESPO will provide information on accommodations at each deployment site, and will provide meeting rooms and field laboratory facilities as required at each intensive deployment site. The Project Office will also make arrangements for common expendables, such as liquid nitrogen and dry ice. Specialized expendables such as

calibration gases are to be supplied by the respective investigator teams. Upon selection ESPO will solicit detailed requirements for expendables and special shipping needs.

Non-NASA investigators should estimate their deployment related travel costs and provide the basis for the estimates, including specific trips, number of travelers, and costs for each trip. Travel costs for NASA employees will be covered by their respective home Centers.

Foreign investigators must bear their own costs for all travel and shipping.

F. Data Products/Archive

The Project Office will serve as a central repository and distribution center for all data products obtained during the CRYSTAL-FACE mission. NASA aircraft Mission Managers, will provide a set of standard "housekeeping" parameters aboard each aircraft, including ambient temperature, dew point temperature, winds, and aircraft position. The aircraft providers will support a data system aboard each aircraft, which will facilitate distribution of these data aboard the aircraft in real time. The aircraft data system may also offer the capability of displaying selected information from investigators aboard the respective aircraft.

The Project Office will maintain a mission data archive for distribution among the Science Team. The mission archive will consist of all data acquired as part of the CRYSTAL-FACE mission. Each investigator team will be responsible for submitting preliminary field results to the Project Office within 24 hours after each flight for distribution to the Science Team during the mission. Final validated measurements from the mission must be submitted to the Project Office within 6 months after completion of the field deployment phase in preparation for public release. The project office will be responsible for submitting the CRYSTAL-FACE data archive to the Langley Distributed Active Archive Center, which will be the repository for all of the mission data.

The Project Office, with the Mission Meteorologist(s), will provide for the acquisition and distribution to the Science Team meteorological data supporting the mission objectives. These data will include meteorological products for flight planning and post-mission products to support analysis and publication of results.

G. Approximate Schedule

Initial meeting of selected investigtors in late fall 2001 or early 2002.
Integration/test flight, Spring 2002
Deployment, July 2002
Post mission workshop Spring 2003

IV. PROPOSAL CONTENT AND FORMAT

The content of the proposal should provide sufficient detail to enable a reviewer to assess the value of the proposed research, its relation to the CRYSTAL-FACE objectives, and the probability that the investigators will be able to accomplish the stated objectives within the requested resources. The technical part of the proposal should be limited to the equivalent of 15 single-spaced typewritten pages in no less than 12 point type size. Each proposal should contain the following materials assembled in the order given.

A. Cover Letter

Each proposal should be prefaced by a cover letter (Appendix D) signed by an official of the investigator's organization who is authorized to legally bind the organization to the proposal and its content. The cover letter should refer to the CRYSTAL-FACE Program. Proposals to serve as Mission Meteorologist must include a separate budget line to support that role.

B. Title Page

The title page should contain the following:

- Reference to the NASA Research Announcement Number
- Title
- Name of the Principal Investigator and proposing organization(s).
- Names, full addresses, telephone numbers, e-mail address, and affiliations of the Principal Investigator and all Co-Investigators.
- Date of submission.
- Budget: Year 1, Year 2, TOTAL

C. Abstract Page

This shall contain a brief statement of the objective of the proposed effort, the measurements planned, and method of approach.

D. Table of Contents

E. Description of Proposed Research

This section should include:

- An introduction: This should clearly define the scientific objectives of the proposed effort and its anticipated contribution to the goals of this program as outlined in the NRA.

- A description of the proposed work: This description should be a full statement of work proposed with the key elements clearly identified and related to each other. The methods or approaches to be used should be clearly described and, as appropriate, the advantages of the selected methods or approaches over alternative ones should be discussed. The planned measurements and/or anticipated results should be identified, and their relation to the stated research objectives should be discussed. **Instrument investigators should identify accuracy, precision and sampling frequency of proposed measurements and relate these to their ability to satisfy mission objectives.**

F. Management Approach

The Management Plan should outline the specific responsibilities of the Principal Investigator (PI) and all other members of the group, and indicate the relationships of these responsibilities within the group. The Management Plan should also identify modeling tools available to the investigators and computer usage plans. The plan should identify what contractor and/or non-institutional support is anticipated and who will be providing it.

G. Cost Plan (U.S. proposals only)

The cost plan should be prepared according to the guidelines of the institution submitting the proposal. Separate budgets should be shown for each 12-month, or partial year. For this NRA, budgets should be provided starting September 1,2001. Do not identify funding requirements by U.S. Government fiscal year. Cost plan(s) should include:

- Cost estimates for direct labor, including individual staff-months and rates for all personnel.

- Estimated costs for computer services.

- Travel costs: The names of all personnel involved in field deployment should be given in an accompanying appendix to the proposal along with their anticipated deployment schedule. For NASA civil service employees, the signature of their management on the proposal indicates a willingness to support necessary travel for the mission from funds appropriated for civil service travel. It is anticipated that the field deployment will last up to 28 days. The proposal should include costs for, and a statement of commitment by, the Principal Investigator and other key personnel, to be in the field for the deployment.

- Overhead rates and costs.

- Other costs, with explanation: Itemize items over $500.

- Contribution from any cost-sharing plan or other support for the proposed research.

- Itemized list of the amount of any contractor or other non-institutional related activities to be supported as part of the proposed investigation.

- Current research funding from other sources, including level of the funding and the title or brief description of the supported research.

- Total cost of support being requested from NASA under this program.

H. Enclosures

Include appropriate descriptions of available facilities, brief resumes of investigators (2pages per person), bibliographies and such other materials, as necessary. The use of binders for proposals and enclosures is discouraged.

I. Logistical Support Requirements

All proposals should include an appendix describing and defining in detail the logistical requirements associated with the proposed investigation. As a minimum this appendix should provide information relative to the airborne instrumentation, field personnel required, and shipping. The minimum requirements should be defined in each of the following areas.

Airborne Instrumentation

Instrument details on space, power, cooling and/or air flow, window access, weight, and other aircraft resources required by each airborne instrument will be important considerations in the selection of the ensemble of instruments to meet the objectives of the respective components of CRYSTAL-FACE. Each investigation should as a minimum define: (1) the proposed aircraft (2) the amount of space that will be required; (3) power required (e.g., 110v, 220v, 3-phase, 60hz, 400hz, and 28vdc); (4) description of inlets/exhausts and/or optical window(s) required; (5) size and number of compressed gas bottles, coolers, pumps, etc., that will required to be mounted external to the rack space defined in (2) above; and (5) cooling flow rate and temperature required to sustain continuous operations under all flight conditions.

Information regarding the size of instrument racks, power, and general operation of instrumentation aboard the ER-2 and WB-57F can be obtained by contacting:

NASA Dryden Flight Research Center
DFRC / Y
MS 1623H
P. O. Box 273
Edwards AFB, CA 93523-0273
USA

Mr. Andrew Roberts
NASA Johnson Space Center
Code CC5
2101 NASA Road 1

Houston, TX 77058
USA
E-mail: andrew.c.roberts1@jsc.nasa.gov
Phone: 281-244-9543

Personnel/Travel

The number of individuals required to operate the proposed instrumentation during flight operations, and the number, if any, of additional non-flight personnel required during the field deployment of CRYSTAL-FACE should be defined along with their proposed schedule for integration and deployment.

Miscellaneous

Special requirements, such as, the need for liquid nitrogen, dry ice, etc., at the integration sites and/or during the CRYSTAL-FACE deployment should be defined. Other non-standard operating procedures and requirements should also be discussed. No supplies will be provided at the overnight sites.

J. Certifications

Certifications Regarding Drug-Free Workplace Requirements, Regarding Debarment or Suspension, and Regarding Lobbying are attached, and are regarded as endorsed via the institutional signature on the cover page.

V. EVALUATION CRITERIA

The following criteria replace paragraph (i) of Appendix C. The first criterion is of highest priority. The remaining three criteria are of equal weight.

1. The overall scientific merit of the investigation, including:

   (a) The technical feasibility of accomplishing the stated scientific goals of the proposed investigation; and

   (b) The relevance of the proposed research to the CRYSTAL-FACE mission's goals and objectives.

2. The competence and relevant experience of the principal investigator and any collaborators as an indication of their ability to carry the investigation to a successful conclusion within the requested resources and Project Schedule.

3. The reputation and interest of the investigator's institution and the willingness of the institution to provide the necessary support to ensure that the investigation can be completed satisfactorily.

4. The cost of the proposed effort including consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

VI. PROPOSAL SUBMISSION INFORMATION

Fifteen (15) copies of the proposal should be submitted. One copy should bear original signatures. Notice of Intent is requested within two weeks after release of this Research Announcement. Notice of Intent and Proposals must be typewritten in English, and they should be sent to:

NRA-01-OES-02
CRYSTAL-FACE
NASA Peer Review Services, Code Y
500 E Street SW, Suite 200
Washington, DC 20024-2760, USA

Any materials sent by courier or express delivery should list the recipient telephone number as 202-479-9030.

Foreign proposers should submit an additional copy to the Office of External Affairs, Earth Research Division. All proposals must be received before the established closing date; those received after the closing date will be treated in accordance with NASA's provisions for late proposals (FAR Supplement 18-15-412, paragraphs A and B).

VII. FOREIGN PARTICIPATION

NASA invites foreign participation in CRYSTAL-FACE in response to this NRA. Important provisions for foreign participation can be found in Appendix C. NASA will bear the cost of integration and flight hours for selected foreign airborne investigations. Foreign investigators will be responsible for all other costs of their investigation, including shipping and travel.

VIII. REQUIRED CERTIFICATIONS

Included with this NRA are certain required certifications and a proposal cover sheet and Budget Summary Form. One set of these completed forms must be included with the original signature version of all proposals.

APPENDIX C

INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS

NASA Federal Acquisition Regulation (FAR), Supplement (NFS) Part 1852.235-72 , Effective JANUARY 2000

(a) **General.**

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRAs contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRAs; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

(b) **NRA-Specific Items.** Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

(c) The following information is needed to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is

desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

(1) **Transmittal Letter or Prefatory Material.**

(i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(v) Identification of other organizations that are currently evaluating a proposal for the same efforts;

(vi) Identification of the NRA, by number and title, to which the proposal is responding;

(vii) Dollar amount requested, desired starting date, and duration of project;

(viii) Date of submission; and

(ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

(2) **Restriction on Use and Disclosure of Proposal Information.** Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

Notice
Restriction on Use and Disclosure of Proposal Information

The information (data) contained in *[insert page numbers or other identification]* of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) **Abstract.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) **Project Description.**

(i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) **Management Approach.** For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) **Personnel.** The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) **Facilities and Equipment.**

(i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points of contact.

(ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

(8) **Proposed Costs (U.S. Proposals Only).**

(i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator,

other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.

(ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.

(iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

(iv) Use of NASA funds--NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted. Additionally, in accordance with the National Space Transportation Policy, use of a non-U.S. manufactured launch vehicle is permitted only on a no-exchange-of-funds basis.

(9) **Security.** Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

(10) **Current Support.** For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

(11) **Special Matters.**

(i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

(d) **Renewal Proposals.**

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

(e) **Length.** Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included

as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

(f) **Joint Proposals.**

(1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

(2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

(g) **Late Proposals.** Proposals or proposal modifications received after the latest date specified for receipt may be considered if a significant reduction in cost to the Government is probable or if there are significant technical advantages, as compared with proposals previously received.

(h) **Withdrawal.** Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

(i) **Evaluation Factors.**

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

(j) **Evaluation Techniques.** Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The

final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

(k) **Selection for Award.**

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

(l) **Additional Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation.**

(1) NASA welcomes proposals from outside the U.S. However, foreign entities are generally not eligible for funding from NASA. Therefore, unless otherwise noted in the NRA, proposals from foreign entities should not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA and, if the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

(2) All foreign proposals must be typewritten in English and comply with all other submission requirements stated in the NRA. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with paragraph (g) of this provision. Sponsoring foreign government agencies or funding institutions may, in exceptional situations, forward a proposal without endorsement if endorsement is not possible before the announced closing date. In such cases, the NASA sponsoring office should be advised when a decision on endorsement can be expected.

(3) Successful and unsuccessful foreign entities will be contacted directly by the NASA sponsoring office. Copies of these letters will be sent to the foreign sponsor. Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of External Relations will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding institution will each bear the cost of discharging their respective responsibilities.

(4) Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

(i) An exchange of letters between NASA and the foreign sponsor; or

(ii) A formal Agency-to-Agency Memorandum of Understanding (MOU).

(m) **Export Control Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation.**

(1) Foreign proposals and proposals including foreign participation must include a section discussing compliance with U.S. export laws and regulations, e.g., 22 CFR Parts 120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular foreign participation. The discussion must describe in detail the proposed foreign participation and is to include, but not limited to, whether or not the foreign participation may require the prospective proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.pmdtc.org and http://www.bxa.doc.gov. Proposers are advised that under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130.

(n) **Cancellation of NRA.** NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.

(End of provision)

Appendix D

Proposal Cover Sheet

NASA Research Announcement 01-OES-02
Proposal No. _____ (Leave Blank for NASA Use)

Title: _____

Principal Investigator::_____

Department:_____

Institution: _____

Street/PO Box: _____

City: _____ State: _____ Zip: _____

Country: _____ Congressional District:_____
(used for database sorting purposes only)
E-mail: _____

Telephone: _____ Fax: _____

Co-Investigators:

Name	Institution & Email Address	Address & Telephone
_____	_____	_____
_____	_____	_____
_____	_____	_____

Budget:
1st Year: _____ 2nd Year: _____ 3rd Year: _____ Total: _____

Certification of Compliance with Applicable Executive Orders and U.S. Code

By submitting the proposal identified in this *Cover Sheet/Proposal Summary* in response to this Research Announcement, the Authorizing Official of the proposing institution (or the individual proposer if there is no proposing institution) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
- confirms compliance with all provisions, rules, and stipulations set forth in the two Certifications contained in this NRA [namely, (i*) Certification of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs, and*

(ii) Certifications, Disclosures, And Assurances Regarding Lobbying and Debarment & Suspension].
Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

Title of Authorizing Institutional Official: _____

Signature: _____ Date: _____

Name of Proposing Institution: _____

Telephone: _____ E-mail: _____ Facsimile: _____

Certification of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The *(Institution, corporation, firm, or other organization on whose behalf this assurance is signed, hereinafter called "Applicant ")* hereby agrees that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1962 (20 U.S.C. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 et seq.), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives federal financial assistance from NASA; and hereby give assurance that it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which the federal financial assistance is extended to it by NASA.

This assurance is given in consideration of and for the purpose of obtaining any and all federal grants, loans, contracts, property, discounts, or other federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for federal financial assistance which were approved before such date. The Applicant recognized and agrees that such federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

NASA FORM 1206

CERTIFICATIONS, DISCLOSURES, AND ASSURANCES REGARDING LOBBYING AND DEBARMENT & SUSPENSION

1. LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 14 CFR Part 1271, as defined at 14 CFR Subparts 1271.110 and 1260.117, with each submission that initiates agency consideration of such applicant for award of a Federal contract, grant, or cooperative agreement exceeding $ 100,000, the applicant must **certify** that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit a Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

2. GOVERNMENTWIDE DEBARMENT AND SUSPENSION

As required by Executive Order 12549, and implemented at 14 CFR 1260.510, for prospective participants in primary covered transactions, as defined at 14 CFR Subparts 1265.510 and 1260.117—

(1) The prospective primary participant **certifies** to the best of its knowledge and belief, that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (l)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

APPENDIX E

Notice of Intent

In order to plan for a timely and efficient peer review process, *Notices of Intent* (NOI's) to propose are encouraged by the date given in this NRA. The submission of a NOI is not a commitment to submit a proposal, nor is information contained therein considered binding on the submitter. NOI's are to be submitted electronically by entering the requested information through SYS-EYFUS Web site located at **http://proposals.hq.nasa.gov/**.

User identifications (IDs) and passwords are required by NASA security policies in order to access the SYS-EYFUS Web site. If you do not have a SYS-EYFUS UserID or password, you may obtain one electronically by going to *http://proposals.hq.nasa.gov* and performing the following steps:

- Click the hyperlink for **new user** which will take you to the Personal Information Search Page.
- Enter your first and last name. SYS-EYFUS will **search** for your record information in the SYS-EYFUS database.
- Confirm your personal information by **choosing** the record displayed.
- Select **continue**, and a User ID and password will be e-mailed to you.

Once you receive your User ID and Password, **login** to the SYS-EYFUS Web site and follow the instructions for **New Notice of Intent.**

At a minimum, the following information will be requested:

- NRA number, alpha-numeric identifier, (Note: this may be included on the Web site template);
- the Principal Investigator's name, mailing address, phone number, and E-mail address;
- the name(s) of any Co-Investigator(s) and institution(s) known by the NOI due date;
- a descriptive title of the intended investigation; and,
- a brief description of the investigation to be proposed.

A separate NOI must be submitted for each intended proposal. Note that this NOI may also be the preliminary version of the proposal *Cover Page/Proposal Summary*; if so, the Web site provides the user future use in updating this information for the final *Cover Page/Proposal Summary* as the deadline for submission of the final proposal approaches.

APPENDIX F

BUDGET SUMMARY

For period from _____ to _____

- Provide a complete Budget Summary for year one and separate estimated for each subsequent year.
- Enter the proposed estimated costs in Column A (Columns B & C for NASA use only).
- Provide as attachments detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost. See *Instructions For Budget Summary* on following page for details.

		NASA USE ONLY	
	A	**B**	**C**
1. Direct Labor (salaries, wages, and fringe benefits)	_____	_____	_____
2. Other Direct Costs:			
a. Subcontracts	_____	_____	_____
b. Consultants	_____	_____	_____
c. Equipment	_____	_____	_____
d. Supplies	_____	_____	_____
e. Travel	_____	_____	_____
f. Other	_____	_____	_____
3. Facilities and Administrative Costs	_____	_____	_____
4. Other Applicable Costs:	_____	_____	_____
5. SUBTOTAL--Estimated Costs	_____	_____	_____
6. Less Proposed Cost Sharing (if any)	_____	_____	_____
7. Carryover Funds (if any)			
a. Anticipated amount : ____			
b. Amount used to reduce budget	_____	_____	_____
8. Total Estimated Costs	_____	_____	XXXXXXX
9. APPROVED BUDGET	XXXXXX	XXXXXXX	_____

INSTRUCTIONS FOR BUDGET SUMMARY

1. Direct Labor (salaries, wages, and fringe benefits): Attachments should list the number and titles of personnel, amounts of time to be devoted to the grant, and rates of pay.

2. Other Direct Costs:
    a. Subcontracts: Attachments should describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting.
    b. Consultants: Identify consultants to be used, why they are necessary, the time they will spend on the project, and rates of pay (not to exceed the equivalent of the daily rate for Level IV of the Executive Schedule, exclusive of expenses and indirect costs).
    c. Equipment: List separately. Explain the need for items costing more than $5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Grant Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the basic research proposed and why it cannot be purchased with indirect funds.
    d. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
    e. Travel: Describe the purpose of the proposed travel in relation to the grant and provide the basis of estimate, including information on destination and number of travelers where known.
    f. Other: Enter the total of direct costs not covered by 2a through 2e. Attach an itemized list explaining the need for each item and the basis for the estimate.

3. Facilities and Administrative (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.

4. Other Applicable Costs: Enter total explaining the need for each item.

5. Subtotal-Estimated Costs: Enter the sum of items 1 through 4.

6. Less Proposed Cost Sharing (if any): Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.

7. Carryover Funds (if any): Enter the dollar amount of any funds expected to be available for carryover from the prior budget period Identify how the funds will be used if they are not used to reduce the budget. NASA officials will decide whether to

use all or part of the anticipated carryover to reduce the budget (not applicable to 2nd-year and subsequent-year budgets submitted for award of a multiple year award).

8. Total Estimated Costs: Enter the total after subtracting items 6 and 7b from item 5.

Required Proposal Forms

A proposal Cover Page is required as part of the proposal, but will not be counted against the page limit. It must be signed by the Principal Investigator and an official by title of the investigator's organization who is authorized to commit the organization. This authorizing signature also certifies that the proposing institution has read and is in compliance with the required certifications printed in full in _____; therefore, these certifications do not need to be submitted separately.

The proposal Cover Page must also be submitted electronically to the SYS-EYFUS Web site located at **http://proposals.hq.nasa.gov/**. If the proposer has submitted an electronic NOI to SYS-EYFUS, the same user UserID and password can be used to complete the electronic proposal Cover Page. SYS-EYFUS will allow you to copy the NOI information into the proposals cover page for you to update as necessary.

If you do not have a SYS-EYFUS UserID or password, you may obtain one electronically by going to *http://proposals.hq.nasa.gov* and performing the following steps:

- Click the hyperlink for **new user** which will take you to the Personal Information Search Page.
- Enter your first and last name. SYS-EYFUS will **search** for your record information in the SYS-EYFUS database.
- Confirm your personal information by **choosing** the record displayed.
- Select **continue**, and a User ID and password will be e-mailed to you.

Once you receive your User ID and Password, **login** to the SYS-EYFUS Web site and follow the instructions for **New Proposal Cover Page.**

A hard copy version of this Cover Page must be printed in time to acquire signatures and include with the original hard copy of the proposal for delivery according to this NRA schedule.

Proposers are advised that they must not reformat this Cover Page after it is printed, as important NASA-required documentation may be lost. Proposers without access to the Web or who experience difficulty in using this site may contact the Help Desk at proposals@hq.nasa.gov (or call 202.479.9376) for assistance. Please note that submission of the electronic Cover does not satisfy the deadline for proposal submission.